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THE PANAMA CANAL: AN EIGHTH-GRADE PROJECT

WORTH McCLURE AND EMMA D. STONE
Gatewood School, Seattle, Washington

Let it be said at the beginning that no attempt is made herein either to justify or to vilify project teaching. New methods of procedure will eventually qualify or be disqualified, not by what is said about them, but rather upon the basis of what happens when they, like new-built ships, are taken out for their "trial runs."

It is from this viewpoint that the record is presented of what may be termed a preliminary trial of the project by an eighth-grade teacher and her thirty-five pupils at Gatewood. If the evidence here adduced be found to contain anything of value to the student of educational problems, the purpose of this paper will have been served.

The pupils in the group under discussion ranged in age from thirteen to seventeen years. At the time the project was undertaken they were beginning the fourth quarter of their eighth-grade work. Almost two-thirds of them had been with their teacher since the opening of the year; the remaining one-third for about ten weeks.

The building of the miniature Panama Canal grew out of the class work in commercial and industrial geography. Several projects were discussed by the pupils before the decision was reached. Certain ones were discarded as too childish; others as uninteresting; still others as too difficult. At length, the group opinion seemed to crystallize. The canal presented engineering difficulties worthy of the efforts of eighth-grade pupils, was interesting to all, and seemed to be feasible.

The next step was to select the engineering staff. This was done by the class after a thorough discussion of the requirements in the way of ability, etc. Three boys were selected because of demonstrated ability to do the actual work of planning and construction. A fourth was added at the teacher's suggestion, a boy whom it was particularly desired to have participate, because it was felt that a share in the responsibilities of the situation might prove to be a timely means for his development along the lines of initiative and self-confidence. It will be interesting to note later the result of his participation.

From this point, the project grew steadily. Not only was it found necessary to modify plans to meet working conditions, but new refinements were continually found to be desirable and new improvements added. The drainage system, for example, was overhauled on the very last day, and exasperating "leaks" were triumphantly sealed. It is especially noteworthy that the interest never lagged during the eight or nine weeks, but rather continued to increase as the difficulties, one by one, were met and overcome. The eldest of the "engineers" struck the keynote of the feelings of the entire class when on the last day of the semester he observed that he would "never be able to wreck her; somebody else will have to do that."

After the staff of engineers had been selected they received their instructions from the teacher. These were brief and simple. First, a working plan should be drawn to scale; then the model should be constructed according to the plans. As to the size of the canal, and the size of their drawings, they were to decide for themselves after reading up on the problem.

It was found after study that a great deal more space was essential than had been estimated at first. The ordinary sand-table would not be large enough to make the model a practical working canal. Therefore, it was decided to construct a sand-table especially for the purpose. This being agreed upon, a new idea was suggested. The teacher was asked for exactly half of the front blackboard. It was pointed out to her that this would permit the working plans to be exactly as big as the canal itself and that a table for the latter might then be placed beneath the blackboard so that work of construction would be simplified and also that visitors might easily refer to the plans for comparison with the model. So it was determined to make the plans 12½ feet long upon the blackboard, and to build the canal the same length upon the table directly below.

The choice of a suitable scale was a problem in itself. Eventually three scales were used. As is the case with most profile maps, the vertical scale was accentuated in order clearly to show the lay of the land along the canal route. It was therefore quite at variance with the horizontal scale. In addition, it was found that the locks would not appear at all on either map or table if the horizontal scale were rigidly adhered to. A third scale, sharply exaggerating the size of the locks, was determined upon for them, so that they might be made actually to function. The profile map, however, failed to satisfy all members of the group. It was argued that a bird's-eye or "aero" view would make the thing vastly more understandable to younger pupils and to visitors. An "aero" view 12½ feet long, thus eventually came to occupy the lower half of the board, the profile map appearing above it on the upper half of the blackboard.

The next set of problems arose from the construction of the table and model itself. A sand-table 5 inches deep and 12 feet long by 4 feet wide was made from portable tables. Sand was used for laying out the landscape, which was modeled after the blackboard plans.

Next came the problem of making the canal, the lakes, and the ocean hold water. Manual arts clay was tried and found unsuitable because it cracked badly and became soft when soaked. Concrete work was considered and given up. Finally, the idea of waterproofing the clay solved the problem. Parowax, applied to the moist clay in several layers, proved an adequate means of holding the bounding main in its proper place. Twenty-five gallons of water were retained in the table by this method.

Before the locks themselves were constructed, a trip was taken to the Lake Washington Canal, for the purpose of studying real locks in operation. Every detail was investigated with the assistance of an obliging guide. The results of this trip were twofold. The first was the abandonment of the idea of building the lock chambers and the gates of concrete, even though the originals were so constructed, and the substitution of wood therefore as a more workable material for miniature construction. The second was an immediate request for more blackboard space, so that a crosssection of the lock chamber, the mechanism of the gates, and the "electric mules" might be displayed. Six feet more of the front boards were allotted for this purpose.

The first set of locks to be built was a dismal failure. Rubber had been cemented to the wood for hinges and for lining the vertical edges of the gates where they meet in closing. After remaining over night in the molds, it was found that water quickly loosened the cement. About this time it was also discovered that in spite of the application of several packages of parowax, the bed of the canal and lakes still leaked sufficiently to cause grave apprehension.

These were the "dark hours" of the project. The engineers arrived early at school and voluntarily remained after hours to work in the shop testing new expedients. Everybody concerned was on the lookout for a cement that would hold in water. To meet the "leak" problem, troughs were devised which caught the penetrating drips and carried them theoretically into a waiting bucket. It was found that there was a science of drainage. The "fall" of the trough was a controlling factor, and finally, the application of parowax to the troughs themselves made the safe drainage of the seepage into the bucket a practical certainty. The lock problem was solved by the use of woolen felt instead of rubber, applied with tiny number-two tacks.

At last the testing day arrived, and the lock chambers and gates were found to function successfully. Another problem arose at this juncture, however. It was found that whereas at the original Panama Canal, water flowing into the ocean from the locks was automatically taken care of, in a small model the excess had to be taken care of by artificial means. A waste pipe was therefore inserted in the Atlantic Ocean and another in the Pacific, and the height of each was carefully gauged so as to carry away the surplus water. The lower end of each waste pipe was in turn connected with the bucket by means of a small gas hose of requisite length.

After the topographical features had all been carefully modeled according to the blackboard plans, several essential improvements suggested themselves. Among these were the items of vegetation, the provision of real boats for demonstration purposes, the coloring of the water to the requisite blue of the tropics, and the drawing of a map of the isthmus, whereby it could be easily explained why the east end of the canal empties into the Pacific instead of the Atlantic Ocean.

There were only seven girls in the room and at their own suggestion they were appointed a "vegetation" committee. Considerable time was spent in research until the vegetation of the Canal Zone was thoroughly understood, after which the work of covering the hills and vales with appropriate verdure was begun. For palm trees, it was found that the vegetative stage of Equisetum (horsetail) afforded a fairly accurate "understudy." Madrona twigs served for rubber trees; several varieties of moss from the depths of the woods represented overhanging growths upon the shore of Gatun Lake; grass tufts did duty as pineapple plantations. A rude shock was dealt the vegetation committee at this stage of the work, however, by the fourth engineer who was, it will be remembered, added to the group through the teacher's influence. His sense of proportion was outraged by the sight of the grove of two-inch palms and he feelingly observed, picking out the tallest of the lot, "Why, that palm is three hundred miles high! That won't do!" The girls were struck speechless for a moment, but only for a moment. The critic was silenced by a counter observation from one of them to the effect that if they were reproduced on scale they couldn't be seen at all! The net result of this episode was the determination to discard a mathematical scale for vegetation, but nevertheless to keep it as near in proportion as the limitations of the human eye and of their resources of material would permit. When the canal was later "demonstrated" to visitors, it was noticeable that care was taken to explain that the vegetation was incapable of representation upon the same scale as that on which the landscape itself was constructed.

The provision of "real boats" for towing through the locks and the actual means of towing were highly fascinating problems. Several diminutive models of ocean liners were made, and three or four of the best were selected for use. These were painted with care, and provision for anchorage was worked out. The "electric mules" of the Canal Zone were reluctantly omitted on account of the time and materials required for construction, and a simple towing device was used. These are typical of the innumerable minor problems which might be mentioned and which continually suggested themselves, as has been stated, even until the last day of the year. It was, no doubt, the daily discovery of new challenges like these that made the interest appear to increase constantly.

For the map of the Isthmus that was found desirable, the teacher relinquished the remainder of her front blackboard. Upon it were shown the general direction and width of the Canal Zone and the peculiar kink in the Isthmus by which the Pacific end of the Canal is thrown to the eastward of the Atlantic end.

The first demonstration was given to the pupils of the room itself. Entirely without direction from the teacher, the four engineers divided the information which they had gathered or which had been given them by other pupils in the room into four "speeches." These covered the following topics: the history of the canal, the geography of the Canal Zone, operation of the canal, and the passage of the locks.

The girls took turns in describing the vegetation. The talks were not written out and so familiar had the boys and girls become with their material that no notes were necessary. It should be noted, however, that all the pupils were accustomed to socialized recitations and therefore had had previous practice in topical discussion. An inaccurate statement from a speaker brought prompt correction from one of his fellows at the conclusion of his remarks. The demonstration before the room was followed by general criticism and discussion of the model itself and of the remarks of the demonstrators. As a result of this, several minor points were polished off before outsiders were invited. The rooms on the upper floor were received one at a time to attend demonstrations. The fame of the project grew, and other rooms made requests through their teachers that they too be allowed to attend. Finally, the principal suggested to all the teachers who had not done so that they arrange for their children to attend at times that would be convenient. Thus, the project became a part of the life of every grade, even down to the first.

It was interesting to note how the speakers changed their remarks to fit the grade of the pupils who were their guests. This had been the subject of much discussion and mutual coaching, it being felt that there were many things beyond the ken of first-graders, or even fourth-graders. Therefore, the talks were surprisingly altered at times, and for the lower-grade guests they were considerably shortened and simplified. Considerable resourcefulness was developed by the speakers in getting down to the level of their auditors. For instance, in beginning a description of the operation of the canal before a first-grade class, the speaker remarked, "Perhaps you have never thought of making water run up hill." He then showed how the water was made to rise in the lock chambers, lifting the boat with it.

In conclusion, it is well to summarize some of the valuable results that accrued, and then note some of the danger points that were discovered.

Among the benefits to the pupils of the room concerned, the following should be noted:

1. The growth that comes from meeting distressing problems and vanquishing them.

2. The growth of initiative. This was illustrated by the continual addition of improvements to the work, as well as by the fact that all of the planning was worked out by the pupils without direction from any source.

3. The development of self-confidence. While partially included under the first item mentioned, it was particularly emphasized by the growing ease and naturalness with which the speakers carried off their parts of the demonstration before adult groups as well as before the pupils.

4. The stimulation of the sense of responsibility. This was notable upon the part of the whole room, and especially upon the part of the leaders. The boy whom the teacher was particularly desirous of having added to the list took charge of all the lettering upon the extensive maps and plans. Weak in carrying responsibility prior to this time, he needed no following up to see that the lettering was clear, neat, and adequate. His sense of proportion has been alluded to in the palm-tree incident, which was typical of

his solicitude for the excellence of every detail of the project. The fact that the whole affair was managed by the boys and girls themselves is good evidence that project work can be made to afford good opportunity for habit formation in this regard. It should be noted here, too, that while thus engaged they were not permitted to exchange one responsibility for another. It was understood clearly at the outset that all formal lessons were to be prepared as usual, and that any delinquency therein was to be made good, regardless of whether incurred through zealous devotion to the project or not. The effect of this was that nobody felt that standards of achievement had been lowered. Hence much of the actual construction work was done before and after school hours. During the "dark days" referred to above, the "engineers" were usually in the shop until about five o'clock or later, and usually had to be sent home.

Some of the benefits to the room and to the school at large were:

1. Fellowship with the teacher.

2. Attitude of pupils in seats during demonstration.

3. The stimulation of school pride. It has already been pointed out that the Panama Canal eventually became "our" Panama Canal. All the rooms on the second floor were keen to keep in daily touch with the latest developments of the work. A report that some new touch had been added would be the signal for numerous visitors at intermissions and after school.

4. Closer relations with the community. While the mothers of the particular room were invited as honored guests at one demonstration, parents of children in other rooms came also. Then, too, one contact point was the carrying home by the children of construction and other problems for parental advice and suggestion. Parents were led to visit the Lake Washington Canal themselves at the instance of their children and were gratified that they had gone.

5. The general interest in the Panama Canal itself which swept the school was a valuable product. The information accumulated was likewise important, though of less significance than the moral values.

Two of the dangerous possibilities to be guarded against in such an exercise:

1. Habit-formation of the wrong kind through the relaxing of accountability. If pupils find that the project can be made to cover a multitude of sins, they will proceed to use it for that purpose. They should not feel that their service on the project entitles them to any immunity from established customs. They should not expect to spend their time at such work to the detriment of any other work that the teacher may prescribe.

2. The teacher herself will need to be on her guard against two dangers. First, there is the feeling that the project is something foreign to school work and that it should be kept apart from the "regular" work. She needs to remember that her children will receive something of value in several subjects from their project service. Her problem is to adjust the course of study so as to utilize these contributions. Second, there is the thought that the project is all-inclusive and that nothing else matters much. This fallacy is born of overenthusiasm and if pursued will not only destroy the moral values of project work but will make it positively harmful to the children through the formation of bad habits. There are some important tools of knowledge which need to be acquired through drill or through other close application. The problem of the project enthusiast is to see that these are not lost in the shuffle.

The resources of the community should not be overlooked. Project work affords a bright opportunity for the school to establish close relations with the homes. Advice and help of parents in the solution of projects should be cordially received by the school. A failure to do this may mean the beginning of a drifting apart of two of the primary factors in the development of the child.